THE AUTHORIZED
RED RIVER
CHLORIDE CONTROL PROJECT
WICHITA RIVER ONLY PORTION

MITIGATION PLAN

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BACKGROUND

The Wichita River Basin Reevaluation (Reevaluation) was initiated in 1998. The proposed project originated from the Red River Chloride Control Project (RRCCP) which had been ongoing since approximately 1957. A Final Environmental Statement (FES) was filed for the entire RRCCP project in 1977 and had the concurrence of federal and state resource agencies. Because of design changes in the proposed project, changes in without-project conditions for the project area, and amendments to the Endangered Species Act, the U.S. Army Corps of Engineers (USACE) re-coordinated the authorized and partially constructed project with the U.S. Fish and Wildlife Service (USFWS), the Texas Parks and Wildlife Department (TPWD), and the Oklahoma Department of Wildlife Conservation (ODWC).

Since 1991, State and Federal fish and wildlife agencies have expressed concerns about the potential impacts of the chloride control measures on the Wichita River Basin ecosystems. Owing to design changes in the original RRCCP, changes in existing project conditions for the project area, amendments to the Endangered Species Act, and the presence of additional species since filing of the FES, it was determined that a supplement to the FES would be required. The proposed project was recoordinated with the resource agencies in accordance with the Fish and Wildlife Coordination Act, and the USFWS issued a Final Fish and Wildlife Coordination Act Report (CAR) for the proposed project dated May 8, 2002. According to the CAR, the USFWS and the ODWC would be unable to support the proposed plan in its present form and recommend that it not go forward as formulated. A summary of concerns from the CAR include:

- Alterations in stream hydrology resulting in changes to vegetative species composition, and vegetative encroachment within the stream channel.
- Changes to water chemistry coupled with increased water withdrawals resulting in reduced aquatic species diversity and abundance.
- Changes to chloride levels resulting in reduced productivity at Lakes Kemp, Diversion and Texoma.
- Decreases in chloride levels resulting in losses to recreational fisheries at Lakes Kemp, Diversion and Texoma.
- Construction of chloride control structures resulting in destruction of mesquite-cedar upland habitat.
- Accumulation of selenium in Truscott Brine Disposal Reservoir resulting in detrimental impacts to resident and migratory wildlife populations.
- Alterations in stream flow and chemistry resulting in elevation changes and chloride reductions at Lake Diversion and consequent impacts to the TPWD Dundee Fish Hatchery.

The CAR also recommended that additional alternatives, besides the 12 TPWD/USFWS alternatives already evaluated, be reviewed for the proposed project including:

- Deletion of Areas VII or X;
- Collection and reintroduction of brines below Lake Diversion;
- Closure of the existing chloride control measures; or
- Creation of a "hybrid" project which could include blending waters from freshwater sources, reclaimed wastewater, or water from new reservoirs.

According to the CAR, the mitigation of proposed project impacts might be nearly impossible to accomplish

in-kind. These impacts included reduced productivity of streams and reservoirs due to reduced chloride levels and increased turbidity. The USFWS, TPWD, and ODWC would be opposed to any reduction in productivity and fisheries at Lake Texoma. However, analysis shows that such impacts would not be anticipated to occur with the proposed plan. The USFWS would not support any alternative until the USACE has developed mitigation measures for impacts to Lake Texoma that satisfy both the TPWD and ODWC.

Since 1991, the USACE has conducted additional environmental studies to address reasonable foreseeable impacts. Based on this technical information, the USACE disagrees with the USFWS as to the severity of impacts attributable to the chloride control measures. The USACE's position with respect to the proposed project remains unchanged for the following reasons:

(1) Proposed project output has changed since the project was originally formulated. The proposed project would be operated for target chloride concentrations of 500 mg/l or less 99% of the time at Lake Kemp with minimal reductions in chlorides at Lake Texoma.

(2) Technical data do not substantiate that the proposed plan would have a significant impact on turbidity and primary productivity in Lake Diversion or Lake Texoma. In fact, turbidity impacts at Lake Texoma approach zero. No reasonable impacts to turbidity, primary productivity, fisheries or recreation would be expected to occur at Lake Texoma. However, technical data do substantiate that significant potential impacts to primary productivity and fisheries could be expected to occur at Lake Kemp as a result of increased fluctuation in pool volumes. Minimal, if any, impacts to fisheries would be expected to occur at Lake Diversion.

(3) Additional environmental studies conducted by USACE during preparation of the DFES indicate some short-term changes to aquatic communities of the upper Wichita River might be likely to occur, but not with the severity reported by the USFWS and natural resource agencies.

(4) The EOP developed for the proposed plan establishes comprehensive and scientifically valid methodologies for establishing existing baseline conditions, establishes environmental thresholds and safeguards for many system components, provides long-term monitoring for impacts attributable to the chloride control measures, and protects against unacceptable changes in the Wichita and Red River ecosystems as well as in Lake Kemp and Truscott Brine Disposal Reservoir. More importantly, it provides a commitment by the USACE to balance authorized project goals with the need to maintain the biological resources throughout the life of the proposed project. The commitments agreed upon in the EOP are summarized in Section 4 of the SFES.

(5) The fully developed project provides the operational flexibility to meet target chloride concentrations while minimizing impacts to the ecosystem. As part of the EOP, chloride concentrations would be continuously measured at target locations and numerous gaging stations throughout the proposed project area to monitor project performance. Results of chloride measurements from this monitoring network would be used to adjust operations at control sites (including elimination of some control sites, if warranted) to balance authorized project goals with the need to maintain biological resources.

(8) The USACE and the project sponsor recognize the potential for change to occur within the project area ecosystem with construction and operation of the chloride control measures. The USACE believes the proposed project could be constructed and operated to meet project goals while assuring the continued function and integrity of the ecosystem and as such, under the intent of NEPA and other appropriate environmental laws and regulations, would: (a) fund and implement the baseline studies and monitoring activities developed and proposed in the EOP, (b) review and act on the recommendations of a peer review committee, and (c) consider for implementation these recommendations, including recommendations to Congress, to suspend operation of the proposed project if unacceptable environmental impacts result from construction and operation of the project.

The USACE believes that by implementing appropriate and reasonable mitigation measures and developing and implementing the EOP, the proposed project should be completed as planned.

The scope of the authorized project has changed to focus only on the completion of the remaining chloride control measures features. The following Mitigation Plan (MP) for Lake Kemp, Truscott Brine Disposal Reservoir and the Wichita River Basin would be implemented by the USACE by replacing or providing substitute resources or environments to compensate for any impact the chloride control measures might cause. Authorized mitigation recommendations for the proposed project include fee acquisition, fencing, and developing approximately 10,000 acres of project land at Canal Creek (Crowell) for wildlife habitat. The different sections included in the MP address:

- Terrestrial Resources,
- Aquatic Resources,
- Selenium, and
- Lake Kemp.

CHAPTER 1

TERRESTRIAL RESOURCES

1.0 BACKGROUND

The proposed project area includes the entire Wichita River Basin. The Wichita River is a south bank tributary of the Red River that drains a long narrow basin of approximately 3,485 square miles in north central Texas.
The Wichita River is formed by the North, Middle, and South Forks which generally flow from southwest to northeast. These streams develop from small intermittent gullies in rolling hills and become perennial streams with well-defined floodplains.

The most significant terrestrial impacts of the chloride control measures would be related to inundation of terrestrial habitat at Truscott Brine Disposal Reservoir. Vegetative communities occurring within the Wichita River Basin would be predominantly a function of human influence. Existing vegetative communities throughout the entire basin include a number of different types composed of the various sub-climax seral stages. True climax communities are largely absent throughout this area having been modified by cultivation, fire control, and grazing.

The Wichita River Basin is dominated by agricultural land use, but soils suitable for farming are more limited and the area is dominated by rangeland used primarily for grazing cattle. Native floodplain vegetation largely has been cleared or fragmented into small, isolated patches and replaced with tame pasture, hay, vegetables, and small grains. Oil and gas production also has fragmented native plant communities. Most of the watershed is a mixture of juniper and mesquite shrubs and grassland, with some areas of cropland. Relatively little irrigated farming exists due to limited amounts of suitable soils, water quality, and water quantity concerns. However, with the proposed project operational and improved water quality, there would be an increase in agriculture production and a noticeable shift in crop yield and cropping patterns on irrigable lands along the Wichita River. Under existing conditions, there are 15,000 acres of irrigated cropland. With implementation of the plan, the USACE estimates there could be an increase to 39,234 acres of irrigated cropland in the Wichita River Basin.

1.1 Riparian Communities

Alteration of the riparian community would most likely be manifested in vegetative and faunal shifts away from salt-tolerant species. An increase in diversity, complexity, or composition of the riparian community would primarily affect vegetative species commonly associated with these habitats. Salt cedar (*Tamarix chinensis*) has become established and dominates the riparian vegetation in many areas of the Wichita River Basin. Encroachment by salt cedar is detrimental because this plant tends to form monocultures having little value for fish or wildlife. Species richness, diversity and density would be increased in the proposed project study area if salt cedar were less abundant in the riparian zone.

With improved water quality, a slow change in riparian vegetation would occur. Streamside plants, which tolerate a higher salinity environment, would eventually have to compete with species that are less tolerant of high salinities. Consequently, over time, species such as willows, cottonwoods, and other bottomland species might invade sites now dominated by salt cedar and other more salt tolerant species.

1.2 Terrestrial Habitat Losses

1.2.1 Proposed Plan

The majority of terrestrial habitat losses would occur due to the expansion of the brine storage reservoir, Truscott Lake, which has already been constructed and has been operational since 1987. At Truscott Brine Disposal Reservoir, the dam could be raised 2.4 feet if required. This would be accomplished by installing a reinforced concrete stem wall atop the existing dam. Raising the level in the lake would change the existing top of dam elevation from 1512.5 to 1514.9. The Truscott spillway crest would be elevated from 1502.0 to1505.3. Raising the top of dam elevation would result in an overall expansion of Truscott Brine Disposal Reservoir from 2,980 acres to 3,700 surface acres, converting existing mesquite-cedar uplands to aquatic brine habitat.

Habitat losses would also occur at the proposed Area VII on the North Fork of the Wichita River 11 miles northwest of Truscott, Texas. The collection facility would consist of a low-water dam and pipeline intake structure. Approximately 72 acres of land would be converted for construction of these features. In addition, approximately 48 acres of habitat would be lost to the construction and operation of the Area VII spray field. The brine transport pipeline would traverse southeast of the Area VII collection area to Truscott Brine Disposal Reservoir. Approximately 181 acres of mixed rangeland and cropland would be needed for the pipeline right-of-way and maintenance road. The maintenance road would be located on top of the pipeline easement. This pipeline/road easement would be 100-feet wide from the approximately 15 miles from the collection area to the outfall, though only 10% of the 100-foot easement would result in habitat loss. The collection facility, spray fields and pipeline would occupy native short-grass prairie rangelands and some croplands.

Once brines from Area VII have been pumped to Truscott Brine Disposal Reservoir, they would pass through a second evaporation spray field. The area of this spray field, used for both Area VII and Area X brines, has been estimated at 28 acres and would convert existing mesquite-juniper uplands to spray field and outfall facilities. Carry out from the spray field would require an additional 28 acres of land.

Habitat losses associated with Area VIII include two spray fields at the intake and outfall of the existing Area VIII brine pipeline. The outfall spray field has already been constructed and is currently in operation. Construction of a spray field at the intake of the Area VIII pipeline would require approximately 37 acres of land. This spray field would be located adjacent to the Area VIII collection facility and would convert existing rangeland to evaporation fields. Carry out from the spray field would require an additional 37 acres of land.

Habitat losses would also occur at Area X which is located approximately 6 miles west of Truscott (Knox County) and 13 miles northeast of Guthrie (King County). The proposed plan would add a spray field at the pipeline intake as well as a pipeline from the collection area to Truscott Brine Disposal Reservoir. The spray field at Area X would occupy approximately 32 aces located some 250 feet southeast of the existing Area X collection facility. The spray field would convert land use from rangeland to evaporation fields. Carry out from the spray field would affect an additional 32 acres of rangeland. Construction of the pipeline from Area X to Truscott Brine Disposal Reservoir would require approximately 146 acres for the pipeline and maintenance road. The service road would be located on top of the pipeline easement. The pipeline/road easement would be 100-feet wide for the approximately 10 miles from the collection area to Truscott Brine Disposal Reservoir. It is estimated that approximately 10% of the 100-foot easement would result in a permanent loss of wildlife habitat.

With the proposed project operational and improved water quality, there would be an increase in agricultural production and a noticeable shift to irrigated agriculture on irrigable lands along the Wichita River and a portion of the Red River. As determined from the Texas A & M studies (2000), most of the agricultural changes would be expected to occur from the conversion of dry land farming of Bermuda grass/hay to irrigated farming of alfalfa. These changes would be not anticipated to result in changes from rangeland or wetlands to irrigated agriculture. Therefore, agricultural changes would be not anticipated to result in loss of wildlife habitat.

2.0 TERRESTRIAL MITIGATION

Crowell Mitigation Area was originally designed and authorized as a brine disposal reservoir for Areas VII and IX, and for other mitigation requirements for the entire RRCCP. However, the area formerly identified and purchased for construction of Crowell Brine Lake would, under the proposed plan, now be utilized for terrestrial mitigation needs. No other terrestrial mitigation alternatives have been evaluated and no incremental cost analysis was required.

The Crowell Mitigation Area is located on Canal Creek, a tributary of the Pease River. The location is about 8 miles northwest of the town of Crowell in Foard County, Texas. Authorized mitigation for the proposed project included: fee acquisition, fencing, developing approximately 10,000 acres at the reservoir, and making those lands available to the Texas Parks and Wildlife Department. The completed acquisition, increased through the acquisition of uneconomic remnants, has 11,954 acres of mitigation lands under Federal ownership. Several management opportunities are being investigated, but as yet have not been determined.

The Crowell Mitigation Area is located within Texas Planning Region 3, immediately south of Copper Breaks State Park, approximately 7 miles north of Crowell, Texas. The Crowell Mitigation Area would provide additional recreation opportunities to supplement Copper Breaks State Park, including equestrian and hiking trails.

2.1 Present Status

Most of the Crowell Mitigation Area has been owned and managed by the USACE since 1991. The area is largely a mixture of shrub and grasslands with relatively small areas of old fields that are no longer farmed except for small food plots maintained by the USACE. Grazing has been eliminated on the area by fencing. The USACE has restored or built ponds, planted shrubs and trees, and planted habitat plots, specifically wheat, to benefit wildlife. The area's wildlife habitat value has noticeably improved with the limited level of management and it now provides good habitat for some species such as dove, scissor-tailed flycatchers, and other migratory birds. The area provides relatively good habitat for many native mammals, reptiles and amphibians. It also supports a good population of quail, deer and turkeys. The USACE is actively managing the Crowell Mitigation Area in accordance with Appendix D of the Master Plan.

3.0 MANAGEMENT PLAN FOR CROWELL MITIGATION AREA

Costs for ongoing operations and management (O&M) of the Crowell Mitigation Area have been estimated to range from $75,000 -$100,000 per year. O&M for the mitigation area would include:

- boundary monumentation and fencing,
- maintenance of fencing, roads, and ponds,
- signage,
- implementation of food plots,

- recreation use management,
- habitat manipulation and,
- habitat development.

The USACE is currently evaluating options for non-government management of the area as well as federal management of the site. The Fish and Wildlife Management Plan for Crowell Brine Lake, Texas is included as Appendix A of this document.

CHAPTER 2

AQUATIC RESOURCES

1.0 INTRODUCTION

Another impact of chloride control measures is the direct and indirect alteration of the hydrology (frequency, magnitude, and seasonality of stream flows), and water chemistry of some portion of the Wichita River Basin. The aquatic community of the Wichita River tributaries is expected to change in two ways following the completion of the proposed project:

1) fish populations downstream of low flow brine storage impoundments may shift toward more salt intolerant species and could experience habitat reductions due to lower flows and
2) reduced chloride concentrations could enhance survivability of some species, including larger piscivorous fishes, which are generally intolerant of high salinities.

1.1 Proposed Project Base Condition

Due to growing concern in the Wichita River Basin about the availability of water and its effect on economic growth and development, the RRA in cooperation with the Texas State Soil and Water Conservation Board (TSSWCB) initiated a study to determine the feasibility of implementing a brush control and management program to increase water yield. The goal is to restore large areas of brush to native grasses, but leave brush buffers and habitat corridors. The results of the study revealed the implementation of the proposed brush control program might be expected to provide a net increase in overall watershed yield ranging from 27.6% to 38.9% (USACE 2001). The brush control program has currently been included in Texas Senate Bill 1 and the Region B (RRA) Water Plan. Implementation is expected to occur regardless of the outcome of the Wichita River Basin Reevaluation. The Reevaluation has used a brush management factor of 50% implementation as its future condition – with or without the proposed project. Low flow base conditions with and without brush management are shown in Table 2-1.

TABLE 2-1
LOW FLOW BASE CONDITIONS BY REACH IN THE UPPER WICHITA RIVER

	Reach 10		Reach 11	Reach 9
	Cfs≤1	Cfs≤0	Cfs≤0	Cfs≤0
Natural Conditions	1.5%*	0.0%	8.9%	1.4%
50% Brush Control – 27.6% Return	NA	0.0%	7.9%	1.4%
50% Brush Control – 38.9% Return	NA	0.0%	7.8%	1.4%

* Percentages rounded to nearest tenth
NA – Not Available
Source: USACE 2001b

Beginning five years after completion of the environmental baseline study, and continuing at five-year intervals throughout the life of the proposed project (estimated at 100 years), the maps and data on environmental conditions would be updated. New imagery of the study area would be obtained, field checks would be made to ensure accuracy of data, and differences between new and old imagery would be analyzed and quantified. Because the Wichita River Basin Project Reevaluation has assumed 50% implementation of

the brush management program, the study area land use would be reviewed to confirm conversion of brushland over time. Plans for confirmation of the base condition are provided in Chapter 3, Section 5.4 of the EOP.

2.0 SOUTH FORK OF THE WICHITA RIVER

A study was conducted by the USACE to assess base flow conditions in Reaches 9, 10, and 11 of the Upper Wichita River. Reach 11, the South Fork of the Wichita River, is associated with Area VIII. While natural conditions are synonymous with observed base flows in Reaches 9 and 10, natural conditions in Reach 11 were calculated based on observed flow plus the average pump rate from Area VIII after initial operation. Therefore, the base flow for Reach 11 estimates stream flow prior to 1987. Base flow rates were taken from data collected by USGS stream gages from October 1961 - September 1998 for Reaches 10 (Truscott Gage) and 11 (Benjamin Gage) while data from December 1959 - September 1979 was used for Reach 9 (Lake Kemp). These results are reported in Table 2-2. Analysis of flow impacts showed that zero-flow days in Reach #11 increased by only 0.27% from natural conditions as a result of the implementation of Area VIII.

TABLE 2-2
UPPER WICHITA RIVER: ZERO-FLOW DAYS W/O BRUSH MANAGEMENT

	Reach 9** Flow ≤ 0 cfs	Reach 10* Flow ≤ 0 cfs	Reach 11* Flow ≤ 0 cfs
No Action Alternative	1.43%	0.015%	8.85%
Proposed plan	1.50%	8.37%	9.11%

*Period of Record 10/61 – 9/98, 13505 days
**Period of Record 12/59 – 9/79, 7604 days
Source: USACE 2001b

2.1 Increased Species Richness

Changes in the composition of fish communities in the Wichita River basin are predicted to occur as a result of the chloride control measures. It has been predicted that species such as the Red River pupfish (*Cyprinodon rubrofluviatilis)* and Red River shiner (*Notropis bairdi)*, which are adapted to high salinity waters, could decrease in numbers as a direct result of habitat modification and from secondary impacts caused by increased competition from less saline tolerant species (USACE 2001a). Within the Red River basin as a whole, the University of Oklahoma (1975) suggested that fish populations could experience a decrease, however none were predicted to be extirpated from the system and 24 fish species were predicted to have a positive response to decreased salinity. Therefore, overall species richness would be increased.

3.0 MIDDLE AND NORTH FORKS OF THE WICHITA RIVER

3.1 Brush Management

Several resource agencies have expressed concern over the projected increase in zero flow days on the upper Wichita River after chloride control measures implementation. The resource agencies were concerned that increases in zero flow days could impact species adapted to the brine flows of the Wichita River. An investigation was initiated to assess the impact of the State's brush control program on low flow days projected for the chloride control implementation. Low flow modeling was performed to assess potential impacts of the chloride control measures and indicated that the Truscott gage, located downstream from Areas VII and X showed the greatest increase in zero flow days with proposed project implementation.

Table 2-3
BRUSH MANAGEMENT IMPACTS ON ZERO FLOW DAYS

Reach	Natural Conditions without brush management	Natural Conditions with brush management (27.6%-38.9% Returns)	Areas VII, VIII, X without brush management	Areas VII, VIII, X with brush management - 27.6% yield increase	Areas VII, VIII, X with brush management - 38.9% yield increase
9[1]	1.4 %	1.4-1.4 %	1.5 %	1.5 %	1.5%
10[2]	0.01 %	0.01-0.01 %	8.4 %	4..5 %	3.3 %
11[2]	8.8 %	7.9-7.8 %	9.1 %	8.2 %	8.1 %

[1] Period of Record 12/59 – 9/.98, 7604 days
[2] Period of Record 10/61-9/98, 13505 days
Source: USACE 2001b

The concept of brush management is to initially restore large areas of brush to native grasses, but leave brush buffers and habitat corridors. Implementation of the brush control program on the North and Middle Wichita Forks of the Wichita River (Reach 10) has the potential of reducing the number of with-project zero flow days from 8.3% to 4.5-3.3% as shown in Table 2-3. Therefore, implementation of the brush control program on the North and Middle Forks of the Wichita River would reduce with-project zero flow day impacts. In reach 9, brush management impacts on zero flow days would be minor, while in Reach 11 brush management would improve with-project conditions over current conditions.

3.2 Area VII and Area X Impacts on Stream Flow

In Reach 10 (Areas VII and X) the percentage of zero-flow days would increase from almost 0% under natural conditions to 8.4% under the proposed plan as shown in Table 2-2. This increase in zero-flow days is of concern to resource agencies due to potential reductions in refugia pools. However, the continuing presence of refugia pools and brine-adaptive species in Reach 11 under natural conditions indicates that this would be a limited concern. Under natural conditions, the zero-flow days in Reach 11 (8.8%) is greater than would be seen in Reach 10 under the proposed plan (8.4%).

3.3 Reduced Chloride Impact

Reduced salinity in the streams for the future without-project conditions (with State brush management program) would occur. In Reach 10, salinity concentrations would decrease, at least 70% of the time; the decrease would be 75% (Areas VII and X); and resulting concentration would be expected to be approximately 1,500 mg/l. In Reach 11, with Area VIII in operation and no brush management, salinity concentrations would decrease, at least 70% of the time by about 64%, and the resulting concentration would be approximately 3,000 mg/l. As a result, species tolerant of salinity levels greater than 10,000 mg/l would likely decrease in relative abundance in habitats of decreased salinity due to an increase in relative abundance of less tolerant species. It is also expected that the brush management program with its increase in watershed yields could cause additional decreases in salinity concentrations in Reaches 10 and 11, which would cause additional impacts on the salt tolerant fish community.

In Reaches 10 and 11, impacts to the salt tolerant community as a result of decreased salinity concentrations would probably not occur over long-term periods of time. Consequently, no impacts would be expected for the downstream portion, Reach 9. Increases in less salt tolerant species in Reaches 10 and 11 would most likely be limited to short-term pulses resulting from above average rainfall events and associated flow

increases. As base flow rates returned, environmental conditions (salinity concentrations) would become less favorable for the less salt tolerant species. Evidence of a similar pulse of less salt tolerant fishes into Oscar Creek (Jefferson County, Oklahoma) has been observed (Pezold and Clyde, unpublished data). Oscar Creek is generally considered to be the easternmost extent of the Red River pupfish. The fish community in Oscar Creek is very similar to the salt tolerant communities of the Wichita River Basin and is primarily comprised of Red River pupfish, plains killifish, and mosquitofish. Field Observations and collections made in May 1994 indicates that fish species more commonly found in less salt tolerant communities can and do move into Oscar Creek for brief periods, as a function of temporal conductivity variations. Subsequent field collections in May 1996 and May 1997 (Table 4-7) indicate that these movements of less tolerant fish species into Oscar Creek occur infrequently and impacts to the salt tolerant community appear to be minimal. Similar patterns would be expected in the upper Wichita River Basin.

4.0 FISH COMMUNITY IMPACT

4.1 Mitigation of Brine Habitat Loss

The goal of the chloride control measures is to reduce brine loadings to the Wichita River. One consequence of the chloride control measures is, therefore, the conversion of brine aquatic habitat to less saline habitat.

In areas upstream of the chloride collection facilities in operation, the structure of the fish community is relatively simple comprised primarily of Red River pupfish, plains killifish, and mosquitofish. The Red River pupfish and plains killifish can tolerate high salinity levels and might be found in water with salinity greater than 100,000 ppm, which is roughly three times the concentration of seawater (Echelle et al. 1972). Echelle et al. (1972) found that, although Red River pupfish are present in low relative abundance within waters with low salinity, they are only highly abundant in waters with salinity greater than 10,000 ppm, where few other species are present. Conversely plains killifish can successfully compete in freshwater environments with a wide range of salinity. Therefore, no mitigation is recommended.

4.2 Mitigation for Flow Impacts

As noted in previous sections, neither concentration nor flow reductions are anticipated to adversely impact fish communities. Therefore, no mitigation is recommended.

CHAPTER 3

SELENIUM

1.0 INTRODUCTION

Brine pumping from tributaries of the Wichita River has the potential to provide benefits to the stream in terms of Se-impacts. Portions of the Wichita River Basin are currently Section 303(d) listed due to impairment by Se. The proposed plan could provide a benefit to the upper Wichita River in terms of reduced Se-impacts. However, the potential for similar impacts could be transferred to Truscott Brine Disposal Reservoir.

Significant Se-impacts at Truscott Brine Disposal Reservoir do not include human health risks from either contact, ingestion of water, or consumption of waterfowl. The primary potential impact does lie with breeding birds nesting at the reservoir.

Considerable discussion has taken place with resource agencies regarding potential Se-related impacts and possible remedial measures for avoiding or minimizing these impacts, should they occur. While the USACE is committed to taking remedial actions for Se impacts, should they appear likely to occur, it believes that the Truscott Brine Disposal Reservoir can be operated safely under the proposed plan. Based on the USACE's best estimate, Se-related impacts, if any, would occur far into the project's life.

2.0 SELENIUM MITIGATION

Mitigation for avoiding selenium impacts would be implemented in accordance with the Selenium Action Plan (Appendix A). With respect to Se remediation, several general categories of potential remedial measures are conceivable given current knowledge of the subject. These categories are provided as examples of potential measures. Site-specific relevance as well as technical or economic feasibility would vary for these measures and may or may not be appropriate for this project. Brief descriptions of potential measures, should they be warranted, are provided below.

2.1 Habitat Alteration to Discourage Nesting of Impacted Bird Species.

If Se-related impacts associated with the proposed project were to occur, these impacts would most likely be associated with decreased reproductive capacity of birds nesting near Truscott Brine Lake. If potentially impacted species can be identified through monitoring, it might be possible to alter limited nesting habitat requirements to discourage nesting of these species in the project area. As a single example, if the affected species prove to be cormorants nesting in inundated dead snags, mechanical removal of these trees might be possible, forcing these birds to abandon the project area in search of more suitable nesting sites. Similar alterations (e.g., placement of rip rap or control of shoreline slopes) to shorebird nesting habitat (if it exists and is limited in areal extent) could be implemented if monitoring identifies these species as affected.

2.2 Food Chain Alteration / Elimination.

As Se-related impacts are largely related to food chain dynamics of aquatic systems, Se impacts could conceivably be mitigated by altering and/or eliminating specific populations of organisms (e.g., algae, invertebrates, fishes) resulting in Se bioaccumulation and transfer to higher organisms (most likely bird species). Due to high chloride levels, species diversity of these aquatic organisms would likely be limited (though numbers of individuals could likely be high) and subject to possible control through alteration in habitat or physicochemical means. Monitoring efforts could identify species for possible control.

2.3 Bioremediation.

Bioremediation techniques involve the use of aquatic organisms in reducing Se levels. Potential treatment systems using bacteria, algae, aquatic plants, and other organisms could be investigated for their applicability to the project. Phyto-remediation using Se-accumulating plants (e.g., canola, kenaf) is an emerging technology receiving increased research attention and is proving promising for Se treatment under certain conditions (Terry and Zayed 1998). Brine inflows could potentially be transported through such systems for reduction of Se loading to Truscott Brine Disposal Reservoir if necessary.

2.4 Enhanced Volatilization.

Atmospheric volatilization has proven to result in significant loss of Se mass in certain aquatic systems (see discussion in USACE 1993). This technique is particularly favorable due to permanent loss of Se from these systems. Volatilization rates are dependent upon a number of physical, chemical, and biological interactions but have been artificially increased with certain amendments. Site-specific research and alteration of conditions favorable to volatilization could conceivably be used to reduce Se mass in project waters.

2.5. Alternate Habitat Construction Using Habitat-Based Protocol.

Another potential remedial technique for Se-related impacts associated with the Wichita River Basin Project could be implementation of habitat-based protocols for Se based on those developed by the USFWS (1995a, 1995b). These protocols, one for determination of compensation habitat and the other for determination of alternative habitat required for impact avoidance, are based on the concept of landscape-level dilution of avian exposure to Se and have been applied in the San Joaquin Valley of California. These protocols could potentially be modified (if necessary) to be applicable to Truscott Brine Lake or other proposed project features.

2.6 Hazing.

Hazing is the intentional disturbance of birds with the intent to keep them from inhabiting certain areas. Hazing has sometimes been employed to prevent crop destruction by birds. Hazing could potentially be employed during the breeding season as a low-cost and effective measure to prevent nesting by birds potentially at risk to Se exposure.

2.7 Induced Changes in Se Speciation.

While dynamics of Se speciation are currently poorly understood, it is known that certain Se species are more prone to bioaccumulation and manifestation of impacts on higher trophic level organisms. Current research indicates that organic forms might be the most environmentally damaging in this respect. As research on this subject progresses, it might be possible to artificially control Se speciation in order to maintain forms with less bioaccumulation potential. Research continues in this area.

2.8 Chemical Treatment.

A potential, but currently costly alternative to mitigating Se-related impacts might be chemical treatment of brines for Se removal. While technically feasible (using techniques such as chemical coagulation with ferric sulfate), these techniques are currently costly in terms of chemical requirements and operation and maintenance costs relative to other measures. However, monitoring data could identify a reduced level of treatment balancing treatment costs and protection of the environment from Se impacts. Emerging technology in this area is likely over the life of the project and could prove useful in addressing Se concerns.

2.9 Alteration/ Management of Vertical Stratification Patterns.

Selenium species favored by chemically reduced conditions have low solubility and may accumulate in deep sediments of vertically stratified aquatic systems. Removal of Se from the water column in these systems can reduce algal uptake, bioavailability, and impacts on higher trophic level organisms. It is very possible that permanent stratification due to brine-induced density differences might develop in Truscott Brine Disposal Reservoir, potentially reducing Se-related impacts. If needed, it is conceivable that stratification patterns favorable to Se reduction could be manipulated through future alteration of brine input elevations and flow patterns.

2.10 Manipulation of Sulfur:Selenium Molar Ratios.

Several authors have reported that sulfur may limit the bioavailability of Se (Maier et al. 1987) or provide significant protection against Se toxicity for certain organisms. Recent research has documented reduced Se bioaccumulation due to manipulation of sulfur:selenium ratios for both algae (Williams et al. 1994) and aquatic invertebrates (Hansen et al. 1993). Manipulation of elemental molar ratios could conceivably be used to minimize impacts in Truscott Brine Disposal Reservoir, if needed, and could prove particularly promising given high sulfate concentrations already present in this system.

2.11 Operational Changes.

Operational changes could include discontinued pumping of brines from one or more source areas. Ultimately, measures could include discontinuation of proposed project.

If measures listed above or other alternative means of control were employed, the range of potential remedial measures for alleviating Se concerns at Truscott Brine Disposal Reservoir or other proposed project features could range from very simple and inexpensive to more complex, costly solutions. Based on current conditions and bird use patterns, some measure employing habitat alteration to discourage nesting semi-aquatic birds would appear particularly suitable for addressing Se-related impacts at Truscott Lake. Intensive bird use surveys during 1997 and 1998 revealed semi-aquatic breeding birds at the lake were limited in both species and numbers and utilized a limited, narrow range of habitat. It is likely that habitat alteration could have been quickly and inexpensively implemented during this period had Se concerns called for such action. While habitat alteration might prove useful under current patterns of bird use and habitat, these conditions could certainly change over the life of the proposed project and require alternate remedial measures. These changing conditions and corresponding corrective measures would be addressed most efficiently by a process-based action plan as provided in the EOP.

CHAPTER 4

LAKE KEMP

1.0 INTRODUCTION

Some members of the public and resources agencies have expressed concern about the changes in water quality in the Wichita River and what effect the change in water of the river would have on Lake Kemp's fish community and overall recreational use of the reservoir. The quantity and availability of habitat required by fishes and other aquatic organisms present in Lake Kemp can be highly dependent upon lake's elevation, affecting habitat availability and spawning and recruitment success.

2.0 TURBIDITY

Natural surface waters typically possess suspended materials consisting of nonliving matter (e.g., clays) as well as biological solids (e.g., algae). The presence of suspended material in water causes absorbance, reflection, and scattering of light. The measurement of the extent of this phenomena is referred to as turbidity and is commonly measured in nephelometric turbidity units (NTUs). Nephelometric turbidity is measured in water by use of an instrument known as a turbidimeter which may be employed in field or laboratory settings. A field turbidimeter in common use for these measurements has a typical accuracy range of +/- 5% of the reading or 2 NTU (whichever is greater) with a resolution of 0.1 NTU (YSI Incorporated 2001).

Turbidity is essentially a function of two sets of factors: those that influence the settling rate of suspended materials (settling) and those that may keep suspended materials from settling (mixing). The addition of suspended materials to surface waters can occur as a result of inflows (e.g., during high flow conditions) or as a result of wind-induced re-suspension of sediments from the lake bottom or shorelines. These factors interact to keep a lake within a general range of turbidities characteristic of that lake. Factors that influence settling include type and size of suspended materials, water temperature, and chemical properties of the water, including ionic strength of water as measured by salinity or total dissolved solids (TDS). Increased TDS can cause an increase in the settling rate of suspended materials by neutralizing ionic forces that keep particles from aggregating and settling (see discussion in Schroeder et al. [2000]). Therefore, a TDS reduction of sufficient magnitude could result in decreased settling rates of suspended materials and an associated increase in turbidity in a lake such as Lake Kemp. Factors that influence mixing include wind and wave action, water currents, and lake stratification.

As a result of USACE studies, considerable data are available regarding turbidity levels in Lake Kemp. Included are results of baseline sampling conducted during 1997 (Wilde 1999) and 1999 (Wilde 2000). Reports for both sampling efforts are available at http://www.swt.usace.army.mil/LIBRARY/Library.CFM. In 1997, average turbidity (n = 858) in Lake Kemp was 15 NTU with a range of 1.38 to 90.6 NTU (Wilde 1999). Average turbidity in 1999 was 34.4 NTU (n = 782) with a wide range of 6.2 to 599.0 NTU (Wilde 2000). Accordingly, it is evident that Lake Kemp is a highly turbid lake which is subject to tremendous spatial and temporal variability in turbidity.

A study designed to evaluate site-specific settling rates in Lake Kemp was funded by the USACE and conducted by the Corps of Engineers Waterways Experiment Station (now ERDC) (Schroeder et al. 2000). The study involved collection of water and suspended materials from Lake Kemp and laboratory determination of settling rates at various levels of TDS reduction anticipated for the proposed project. Results of this study are incorporated by reference at http://www.swt.usace.army.mil/LIBRARY/Library.CFM.

Owing to an updated period of record and inclusion of the most recent gage data, concentration duration curves (USACE 2001b) for the proposed project are slightly different than those evaluated by Schroeder et al. (2000). In order to evaluate potential changes in Lake Kemp turbidity for the proposed plan for chloride

control (Areas VII, VIII, and X in the Wichita River Basin), impacts of anticipated TDS levels from updated concentration/duration curves (USACE 2001b) with and without (defined by current conditions including brine reductions at Area VIII) the proposed plan on Lake Kemp settling rates were compared using site-specific information and methodology from Schroeder et al. (2000). This involved application of regression equations relating TDS concentrations and sedimentation rate constants (1/hr) as presented in Figure 3 of Schroeder et al. (2000) to with- and without project TDS levels for the three initial turbidity levels (8, 24, and 43 NTU) evaluated by these authors. Once sedimentation rate constants were developed using these methods, first order sedimentation was estimated using the equation:

$$N = N_0 e^{-kt}$$

where N is turbidity at time t, N_0 is the initial turbidity (t = 0), and k is the sedimentation rate constant (1/hr) derived as described above (Schroeder et al. 2000). Resulting pre- and post-project turbidity values were compared as a measure of the differences that might be expected in turbidity reduction following a "turbidity inducing" event in Lake Kemp with and without the proposed project. Results were obtained for 1, 5, 50, 95, and 99 "equaled or exceeded" TDS levels as contained in concentration duration curves (USACE 2001b).

Results of existing (natural) and post-(modified) project turbidity reduction evaluations for the 50% "equaled or exceeded" estimate for Lake Kemp are shown in Figures 4-1 (8 NTU), 4-2 (24 NTU) and 4-3 (43 NTU). For the 8 NTU evaluation, the maximum pre- and post-project turbidity difference is 1.58 NTU after approximately 4 days of settling with an average difference of 1.30 NTU over a 10-day settling period (Figure 4-1). Schroeder et al. (2000) defined "final" turbidity changes as differences in turbidities following 7 days of settling. For the 8 NTU evaluation (Figure 4-1), this difference in final turbidity is 1.36 NTU. For the 24 NTU evaluation (Figure 4-2), the maximum turbidity difference is 4.00 NTU after 3 days of settling with an average difference of 2.85 NTU over a 10-day settling period. Difference in "final" turbidity for this initial turbidity level is 2.56 NTU. For the very high (43 NTU) evaluation (Figure 4-3), the maximum turbidity difference is 7.5 NTU after 2 days of settling with an average difference of 4.3 NTU over a 10-day settling period. Difference in "final" turbidity is 2.9 NTU. Based on these analyses, predicted differences in pre- and post- project turbidities for Lake Kemp would be relatively minor for a highly turbid reservoir with tremendous variability in turbidity levels.

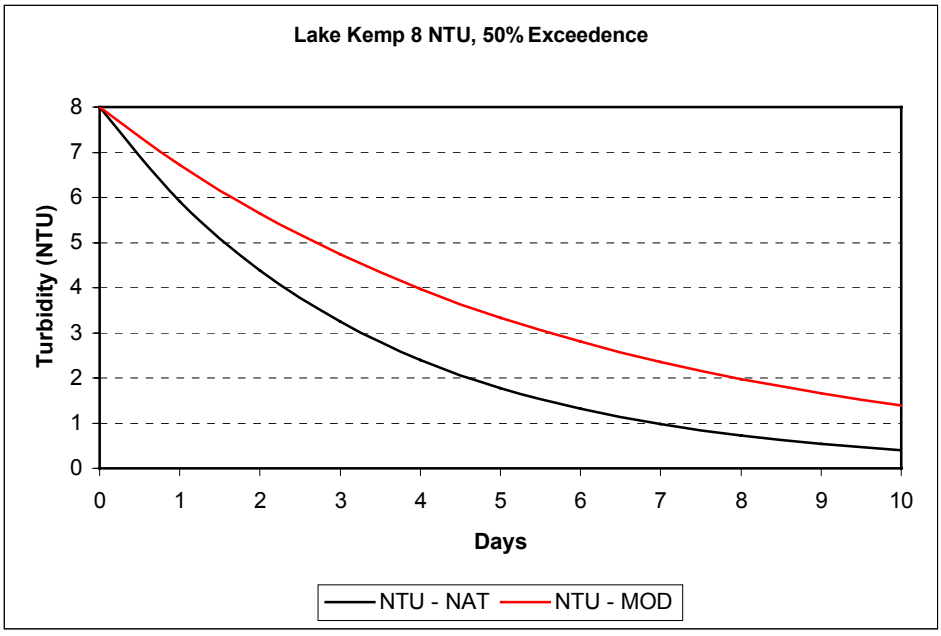

FIGURE 4-1

COMPARISON OF PRE- (NAT) AND POST-(MOD) PROJECT TURBIDITY REDUCTIONS, 8 NTU, LAKE KEMP, TEXAS

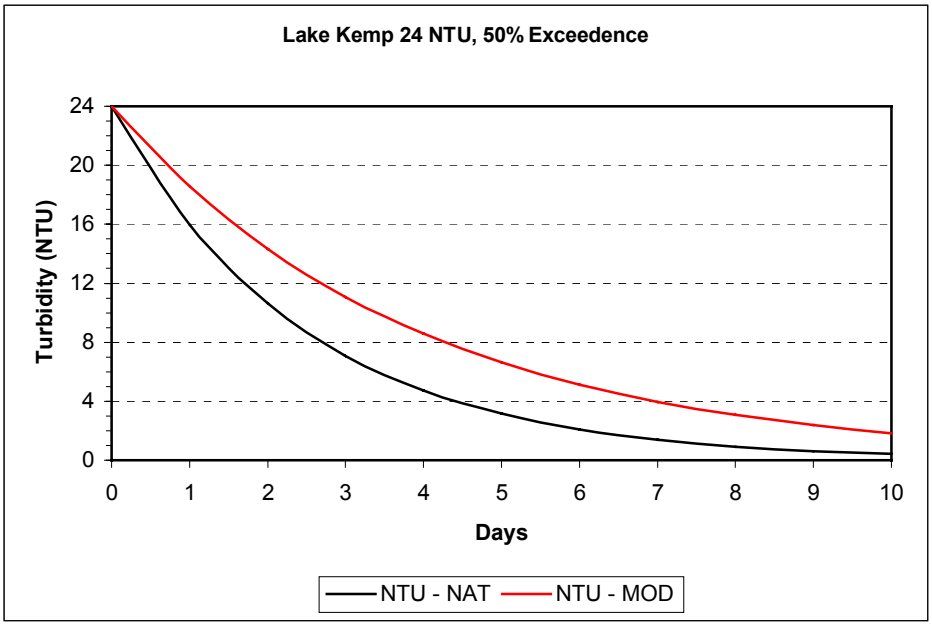

FIGURE 4-2
COMPARISON OF PRE- (NAT) AND POST-(MOD) PROJECT TURBIDITY REDUCTIONS, 24 NTU, LAKE KEMP, TEXAS

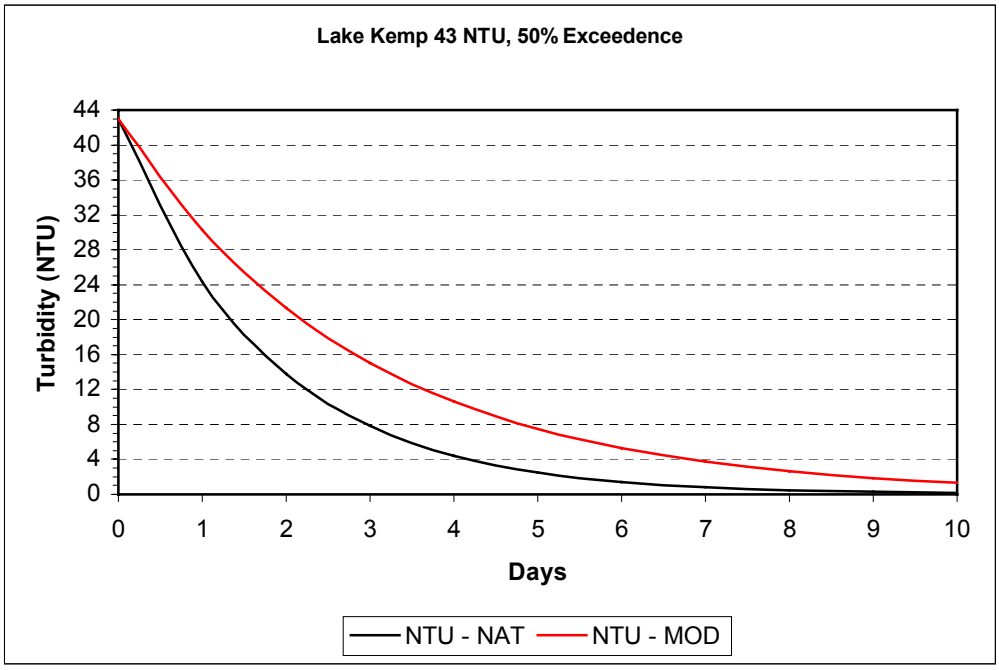

FIGURE 4-3
COMPARISON OF PRE- (NAT) AND POST-(MOD) PROJECT TURBIDITY REDUCTIONS, 43 NTU, LAKE KEMP, TEXAS

In summary, anticipated pre- and post-project changes in solids settling dynamics and turbidity in Lake Kemp were evaluated using site-specific settling data. Resulting differences were estimated to be relatively minor for a highly turbid reservoir subject to significant variability in turbidity levels. Accordingly, project-related impacts associated with turbidity-induced decreases in reservoir primary productivity and associated impacts to the lake fishery would be conceivable, though thought to be minor and not presently quantifiable. Monitoring of project-related impacts has been included in the project EOP.

3.0 LAKE KEMP ELEVATION

Based on data obtained from the USACE 2000 Annual Report, the long-term average inflow for Lake Kemp is 188,600 acre feet/year. This long term average is based a period of record from 1924 to 2000. The average annual inflow for the period of record, 1962-1998, used in the low flow/concentration duration analysis is 177,153 acre feet/year. A review of inflows from 1988-2000 for Lake Kemp, the period of record after construction of Area VIII, reveals an average annual inflow of 186,952 acre feet/year. This indicates that the removal of brine flows from the upper reaches of the basin have minor effects on the inflow into Lake Kemp.

The proposed plan is expected to increase water demands on Lake Kemp due to improved water quality as well as from diversion of brine flows. Water usage under the proposed plan water use model was increased by 61,222 acre feet/year for simulation purposes as shown in the following sections. Elevation duration data indicates that under existing conditions Lake Kemp is at or above elevation 1123 91.2% of the time. Under the proposed plan with brush control implemented at the Truscott gage, Lake Kemp is expected to be at or above 1123 48.0% to 48.6% of the time. With brush control implemented in 50% of the entire basin, Lake Kemp is expected to be at or above elevation 1123 51.5% to 53.8% of the time. The increased water demand on Lake Kemp under the proposed plan would result in wider fluctuations in elevation. These wider elevation fluctuations would not be interpreted to mean that insufficient storage is available to meet future water demands at Lake Kemp. As the duration data indicates, Lake Kemp would experience lower elevations but would recover as wetter periods are experienced.

Lake elevation duration analysis for the period of record (October 1949 though December 2000) was performed for three assumptions:

- The top of the conservation pool in Lake Kemp is 1144 feet NGVD,
- Flood control storage between 1144 feet and 1145 feet NGVD is managed for a controlled drawdown to maximize water supply availability for municipal, industrial, and irrigation uses, and
- Brush management in the Wichita River basin between all three collection areas and Lake Kemp is expected to be implemented within about 50% average of the basin area as part of the state water plan over the life the project life.

Occasionally (not more than 13.1% of the time) the elevation of Lake Kemp is higher than 1144 feet NGVD (top of conservation pool) but less than 1145 feet NGVD (first foot of flood control storage). With this in mind, elevation duration models under with- and without-project conditions were constructed assuming a maximum elevation in Lake Kemp of 1145 feet NGVD. Brush management plans formulated by the RRA in cooperation with the TSSWCB have projected an increase in overall watershed yield per area of treatment to range between 27.6 to 38.9% (RRA 2000) as shown in Table 2-3. Elevation duration and hydrograph analyses incorporated into the Lake Kemp elevation model based on an estimate of 50% achievement in brush management efforts using the more conservative watershed yield estimate of 27.6% per unit of treatment were used in this evaluation.

4.0 IMPACTS

4.1 Spawning

During the spawning season, nest site selection, nest construction, and spawning can be adversely affected by reservoir drawdown (Baxter 1977). Largemouth bass, crappie, bluegill, and catfishes are the primary sport fish in the reservoir that could be affected by reservoir drawdown during their spawning period. For majority of the sport fish species in Lake Kemp, the spawning season starts in March and is completed by the end of May (for species with the exception of catfish). It would be noted that the striped bass, striped bass-white bass populations and to a given extent the largemouth bass population in Lake Kemp are maintained through an intensive stocking program (ie. they do not reproduce effectively in Lake Kemp).

Lake elevation fluctuations from the most recent 10-year period of record (January 1991 through December 2000) under both with- and without-project conditions in order to determine if elevation fluctuations during the spawning season would hinder nest construction and spawning. The 10-year period of record used in this evaluation was chosen so that the most recent TPWD fisheries surveys could be incorporated into the impact assessment. As shown on Table 4-1, fluctuations in the reservoir's elevation during the spawning season were predicted to be quite similar under with- and without project feature (-3.18 to +2.79 feet vs. –4.57 to +9.35). In general, these data suggest that during the spawning season, under with- and without- project features, elevations remain relatively stable and spawning would not be affected. Based on TPWD estimates of population stability and spawning success in Lake Kemp (TPWD 1993; 1996; 1999), habitat (gravel and rocky shoreline) is available in sufficient quantities that the proposed action would not impact spawning success rates of sport fish species in the lake (Table 4-2).

TABLE 4-1
ELEVATION FLUCTUATIONS IN LAKE KEMP DURING SPAWNING SEASON

Year	Without-Project Conditions (50% Brush Management and 27.6% Watershed Yield	With-Project Conditions (50% Brush Management and 27.6% Watershed Yield)
1990	0	0
1991	1.72	1.41
1992	0	0
1993	0	0
1994	0.17	0.74
1995	3.76	3.08
1996	(3.63)	(3.55)
1997	1.61	0.85
1998	(2.76)	(2.64)
1999	3.13	3.53
2000	(3.17)	(2.80)

TABLE 4-2
LITTORAL HABITAT TYPES AT LAKE KEMP

	1995 (Elevation 1144.0)			1998 (Elevation 1136.5)		
Littoral habitat type	Miles	Percent of total	Acreage	Miles	Percent of Total	Acreage
Riprap	9.2	8.3		0.4	0.6	
Rocky Shoreline	65.6	59.4		34.1	48.5	
Eroded Bank	8.6	7.8				
Sandy Beach	0.4	0.4				
Flooded Terrestrial Vegetation	23.6	21.4				
Emergent Vegetation	0.2	0.2	<1			
Featureless	1.6	1.4		13.7	19.5	
Gravel Shoreline				22.1	31.4	
Total Shoreline Length	110.4					
Habitat adjacent to shoreline						
Standing Timber	57		730	10.6		418
Boat Docks	22			13.2		76

(from TPWD 1996 and 1999)

4.2 Impact on Recruitment

Emergent aquatic vegetation and submerged terrestrial vegetation are generally considered the most critical littoral zone habitat required for the survival of young fish (successful recruitment). In Lake Kemp, emergent aquatic vegetation and submerged terrestrial vegetation comprise 0.2 and 21.4% of the littoral zone when the reservoir is at elevation 1144 feet NGVD, but neither habitat type are present in the littoral zone when the reservoir is at elevation 1136.4 feet NGVD (Table 4-2). Elevation duration predictions based on period of record (October 1961 through September 1998) predict that without the proposed project the reservoir would be at or above elevation 1144 feet NGVD approximately 33% of the time and with the proposed project this elevation is achieved only 13% of the time. After the 1995 littoral zone habitat survey, which was conducted when the reservoir's pool elevation was 1144 feet NGVD, the TPWD indicated that habitat for successful recruitment was extremely limited in Lake Kemp (TPWD 1996). When the reservoir is full (elevation 1144 feet NGVD or higher), most of the desired habitat is provided by submerged terrestrial vegetation (21.4 of the 21.6% provided by the two habitats). However, the pool elevation only has to drop a foot or two and submerged terrestrial vegetation is no longer available for fish to use. Presently, recruitment of sport fish in Lake Kemp is being adversely affected by the lack of desired littoral zone habitat and this condition would continue with the implementation of the proposed action.

5.0 MITIGATION MEASURES

The USACE agrees that mitigation could be required for Lake Kemp fishery losses related to operation of chloride control structures. The USACE recognizes that impacts to some species may be unmitigable; however, year class losses to some species can be partially mitigated through supplemental stocking in years when losses can be validated by scientific fishery surveys conducted by TPWD as part of their ongoing fishery management activities and reservoir operations. Also, habitat manipulation and alternation can be implemented to help mitigate for recruitment and availability of shoreline habitat loss. Brush rows strategically placed in selected coves would be provided to help with successful recruitment of sport fish. Also, if warranted, periodic stockings of individuals of affected species (largemouth bass) could assist in

mitigating this potential impact of the proposed plan. Specific, mitigation measures would need to developed and implemented on a local level with coordination through the USACE, USFWS, and Texas Parks and Wildlife. Implementation of these features is therefore recommended.

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APPENDIX A

CROWELL MITIGATION AREA
FISH AND WILDLIFE MANAGEMENT PLAN

CROWELL BRINE LAKE, TEXAS

PRELIMINARY
APPENDIX D
FISH AND WILDLIFE MANAGEMENT PLAN

DESIGN MEMORANDUM ___
TO
MASTER PLAN

July 20, 1998

Department of the Army
Tulsa District Corps of Engineers

CROWELL BRINE LAKE, TEXAS

PRELIMINARY
APPENDIX D
TO
DESIGN MEMORANDUM ___
MASTER PLAN
FISH AND WILDLIFE MANAGEMENT PLAN

I - INTRODUCTION

1-01. **Purpose.** This plan is designed to set forth criteria, goals, and objectives for management and improvement of the fish and wildlife resources of Crowell Brine Lake.

1-02. **Authority.** The Red River Chloride Control Project was authorized for water quality control by the Flood Control Act of 1966 (Public Law 89-789), as amended by the Water Resources Development Acts of 1974 (Public Law 93-251) and 1986 (Public Law 99-662). A Final Environmental Statement (FES) for the project, dated July 1976, was filed with the Environmental Protection Agency on May 18, 1977, and published in the Federal Register on May 27, 1977. Recommended mitigation measures for the project were contained in a U.S. Fish and Wildlife Service (USFWS) Coordination Act report dated May 4, 1976. The Tulsa District's response to their recommendations were included in Design Memorandum No. 25 dated July 1976.

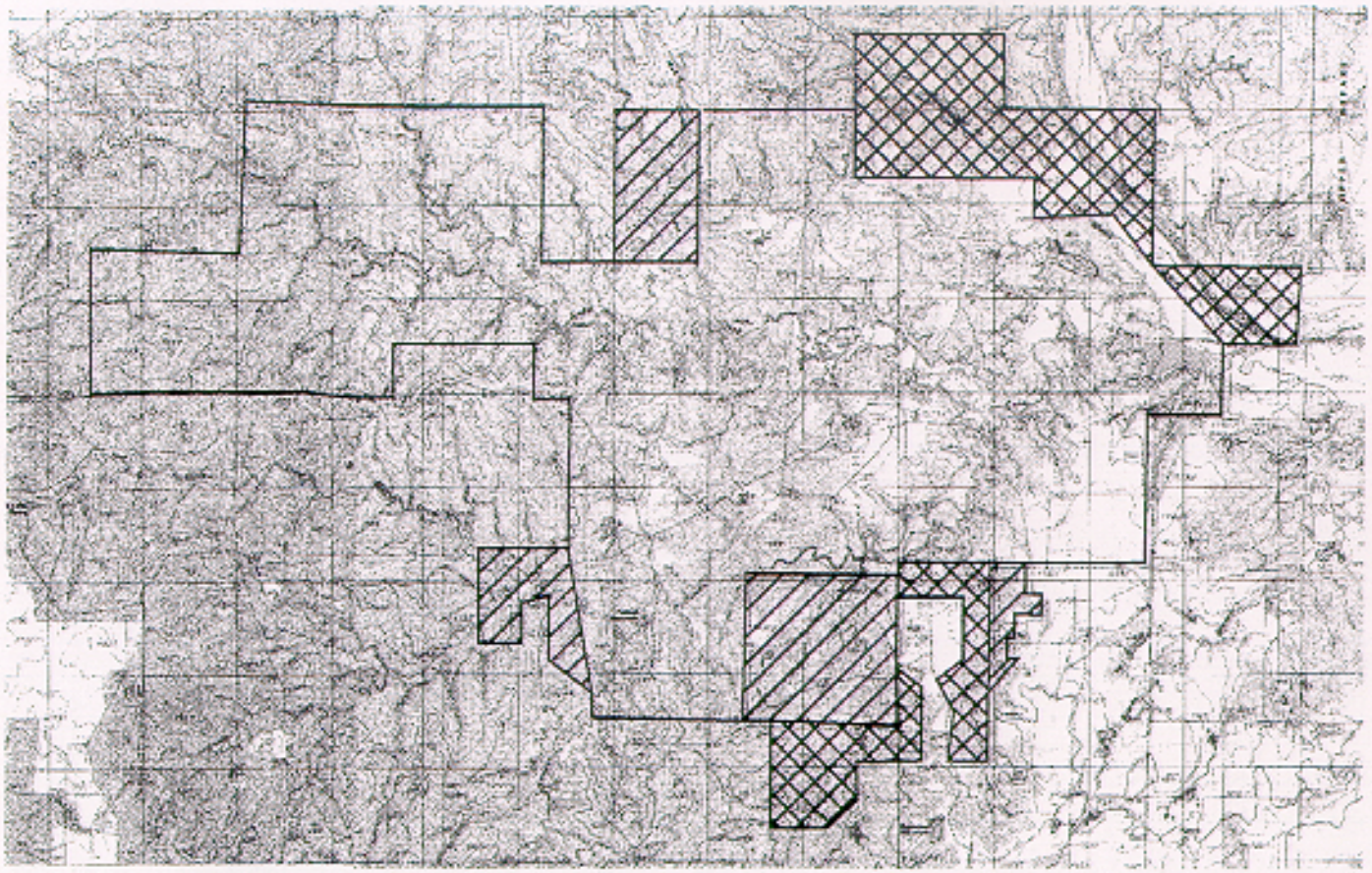
Authorized mitigation recommendations for the project included fee acquisition, fencing, and development of approximately 10,000 acres of project land at the Canal Creek (Crowell) brine pool and making the land available to the Texas Parks and Wildlife Department (TPWD) for wildlife management purposes.

Approximately 10,000 acres of project lands have been purchased at this location (reference Figure 1). By letter dated January 29, 1998, the District asked the TPWD to take license to these lands for wildlife management purposes. The TPWD replied by letter dated March 31, 1998, and declined to assume the responsibility for administering the property due to budgetary constraints. Mitigation for construction of the operational features of the project is still required and is the responsibility of the District since the TPWD declined license to the area.

This plan is prepared in accordance with the Fish and Wildlife Coordination Act of 1958 (Public Law 85-624), as amended; Army Regulation 420-74; Engineering Regulation (ER) 1130-2-400; ER 1105-2-200; ER 1120-2-400; ER1105-2-129; and the National Environmental Policy Act (Public Law 91-190), as amended.

1-03. **Objectives.** The objectives of this plan are to:

a. Develop and manage the area for mitigation of fish and wildlife resource losses associated with construction and operation of the Red River Chloride Control Project.

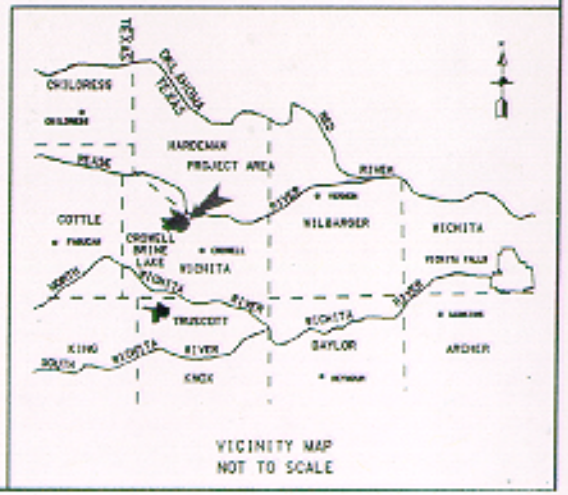


Purchased/Fenced

Purchased/Needs Boundary Fence

Not Purchased

CROWELL BRINE LAKE MITIGATION AREA



VICINITY MAP
NOT TO SCALE

FIGURE 1

b. Develop and manage the area for maximum hunting and fishing utilization and success.

c. Provide opportunities for non-consumptive use of all natural resources.

d. Preserve and maintain, insofar as possible, the integrity of all existing ecosystems.

1-04. Agency Responsibilities.

a. Resident fish and wildlife belong to the State of Texas regardless of land ownership. The State, through the TPWD, has the authority and responsibility to preserve, manage, and regulate all resident fish and wildlife. Both the USFWS and the TPWD are responsible for the conservation and management of all migratory animals. Both the USFWS and Tulsa District are responsible for conservation and management of Federally listed threatened and endangered species. The TPWD has responsibility for conservation and management of State listed threatened and endangered species. The Corps of Engineers has responsibility to restore, improve, and maintain fish and wildlife through appropriate practices and habitat development.

Section 3 of the Fish and Wildlife Coordination Act makes provisions for the use of civil works projects for the conservation, maintenance, and management of fish and wildlife and their habitats. Land and water areas under the jurisdiction of the Department of the Army may be made available to State wildlife agencies by license agreement or by cooperative agreement with the Secretary of the Interior under the terms of a General Plan approved jointly by the Secretary of the Army, the Secretary of the Interior, and the head of the wildlife agency. For areas not managed through licenses or other formal agreements by wildlife agencies, Corps of Engineers stewardship of these resources will be accomplished through implementation of a fish and wildlife management plan. Implementation of the fish and wildlife management plan is subject to the primary purposes for which the areas were zoned. If conflicts exist between this plan and the primary use of the area, the primary use (mitigation) will be given priority.

b. Department of Interior, U.S. Fish and Wildlife Service. The USFWS is responsible for providing technical advice and planning assistance to State and other Federal agencies to preserve and improve fish and wildlife resources. Conservation and management of migratory wildlife and Federally listed threatened and endangered species are the primary responsibilities of the USFWS.

c. Texas Parks and Wildlife Department. Conservation and management of fish and wildlife resources and State listed threatened and endangered species within the state is the primary responsibility of the TPWD. The TPWD is striving to:

(1) Maintain acceptable levels of native and exotic species commensurate with their benefits to man.

(2) Provide diversified recreational use of fish and wildlife.

(3) Insure the survival of fish and wildlife and insure that all people have equal opportunities to use these resources.

(4) Publicize and encourage the conservation and appreciation of fish and wildlife species.

II - AQUATIC

2-01. General. As authorized, Crowell Brine Lake was to be constructed at river mile 1.6 on Canal Creek, a tributary to the Pease River, approximately 5 miles northwest of Crowell, Texas. Canal Creek is a small intermittent stream with limited aquatic resources.

Fishery resources in Canal Creek are restricted due to stream order and intermittent flows. During times of freshwater flow and runoff, species may migrate up the creek from the Pease River. Fish species that have been collected from the Pease River system include the black bullhead (*Ameirus melas*), river carpsucker (*Carpiodes carpio*), red shiner (*Cyprinella lutrensis*), Red River pupfish (*Cyprinodon rubrofluviatilis*), common carp (*Cyprinus carpio*), Gizzard shad (*Dorsoma cepedianum*), plains killifish (*Fundulus zebrinus*), mosquito fish (*Gambusia affinis*), silvery minnow (*Hybognathus nuchalis*), plains minnow (*Hybognathus placitus*), channel catfish (*Ictalurus punctatus*), green sunfish (*Lepomis cyanellus*), orangespot sunfish (*Lepomis humilis*), bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis megalotis*), speckled chub (*Macrhybopsis aestivalis*), largemouth bass (*Micropterus salmoides*), emerald shiner (*Notropis atherinoides*), Red River shiner (*Notropis bairdi*), ghost shiner (*Notropis buchanani*), chub shiner (*Notropis potteri*), sand shiner (*Notropis stramineus*), suckermouth minnow (*Phenacobius mirabilis*), fathead minnow (*Pimephales promelas*), bullhead minnow (*Pimephales vigilax*), and white crappie (*Pomoxis annularis*). Most of these species would be unlikely to occur in Canal Creek other than near its confluence with the Pease River.

Several farm ponds are located within the mitigation area and constitute the major aquatic resources that have management potential for warmwater species. Characteristic species found in ponds of this region include green sunfish, bluegill, orangespot sunfish, largemouth bass, crappie, common carp, black bullhead, and channel catfish.

2-02. Fishery Management Responsibilities. Fishery resource management of Crowell mitigation lands is primarily the responsibility of the Corps of Engineers, since the TPWD declined license to the area. The TPWD shall be consulted, however, for technical advice and planning assistance.

2-03. Major Species To Be Managed. Existing farm ponds are the major aquatic resources that have management potential. Primary species to be managed include bluegill sunfish, largemouth bass, and channel catfish. Management practices to be implemented should include the following:

a. Farm ponds.

(1) Inventory and characterize existing ponds for management potential.

(2) Survey all ponds containing fish populations and develop management strategies/plans to improve fishing and productivity.

(3) Drain ponds and restock with desirable sport fish species if ponds contain few sport fish and/or large numbers of rough fish species.

(4) Fertilize ponds to increase biological productivity.

(5) Monitor ponds for growth of aquatic macrophytes and implement a control plan, if needed.

(6) Implement harvest regulations or conduct supplemental stocking if ponds become overharvested.

(7) Insure public access to ponds for outdoor recreational activities.

(8) Monitor ponds for suitable water quality periodically during summer months.

b. Streams.

(1) Conduct periodic stream surveys of Canal Creek and develop a quantitative list of fish species and populations using Canal Creek.

(2) Protect riparian vegetation and grasses along the banks of Canal Creek.

(3) Monitor stream water quality to insure integrity of the resource.

(4) Consult with USFWS and TPWD if any State or Federally listed threatened or endangered fish species are present.

III - TERRESTRIAL

3-01. General. The ***primary*** purpose of these lands is for management of fish and wildlife resources and to provide opportunities to the public for fishing and hunting.

Hunting is to be in accordance with Federal and State regulations and will be permitted on all mitigation lands. Public hunting areas will be signed and shown on public hunting maps. Signs indicating "Public Hunting Area" will be erected at entrance points to all project lands open to hunting.

3-02. Existing Wildlife Habitats. The mitigation lands are located in the Rolling Plains biotic District described by Blair (1950) or in the Mesquite-Buffalo Grass Province described by Bailey (1980). The four major vegetative components of Crowell Brine Lake are woodland, mixed shrub savannah, upland grassland, and bottomland grassland. Two minor vegetative types include a riparian community along Cedar and Canal creeks and a small marsh community around the larger farm ponds.

a. Woodland Vegetation Type. This vegetation type exists primarily on the escarpments bordering the level areas of the uplands and on steplike benches below steep ridges. The vegetation is dominated by junipers (*Juniperus monosperma* and *Juniperus pinchotii*). Other species commonly associated with the junipers are sumacs (*Rhus aromatica* and *Rhus trilobata*), mesquite (*Prosopis glandulosa*), pea-bush (*Dalea formosa*), and condalia (*Ziziphus obtusifolia*). The common grass species in this association are little bluestem (*Andropogon scoparius*), sideoats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), and three-awn grasses (*Aristida spp.*). These areas have little agricultural value, but provide habitat for wildlife species.

b. Mixed Shrub Savannah Vegetation Type. This vegetation type occurs on the more gently sloping areas that are underlain by soils of the Vernon-Badland Complex and are adjacent to the steeper areas of the Woodland Vegetation Type. Under climax conditions, grasses primarily dominate them. Past disturbance by grazing has apparently caused an increase in the number of shrubs, converting the climax grassland into a savannah disclimax. Shrub species found in this association include junipers, mesquite, squawbush sumac (*R. trilobata*), condalia, and algerita (*Berberis trifoliolata*). The shrubs are more widely spaced than those of the adjacent Woodland vegetation type. Grasses, such as blue grama (*Bouteloua gracilis*) and sideoats grama, that decrease in cover with increased grazing pressure have been largely replaced by grasses that increase under such conditions: three-awns, tridens (*Tridens spp.*), tobosa (*Hilaria mutica*), and buffalo grass (*Buchloe dactyuloides*). Areas that have been severely overgrazed have been invaded by cacti (*Opuntia leptocaulis* and *O. phaeacantha*), yucca (*Yucca angustifolia*), and various species of annual forbs.

c. Upland Grassland Vegetation Type. The more level areas that are underlain by soils of the upland Tillman series support a grassland vegetation community. Under climax conditions, these areas appear capable of supporting such grasses as blue grama, sideoats grama, vine mesquite (*Panicum obtusum*), Arizona cottontop (*Trichachne californica*), and western wheatgrass (*Agropyron smithii*). Because of overgrazing, these grasses have decreased in abundance and have been replaced by tobosa grass and buffalo grass. The shrubs (mesquite and condalia), cacti (*Opuntia leptocaulis*), and annual forbs are common on most of the sites and are the result of overgrazing. This community has been severely overgrazed.

d. Bottomland Grassland Vegetation Type. This vegetation community is found on the nearly level areas of the bottomlands that are underlain by alluvial soils. Under climax conditions, this vegetation community is dominated by tall and mid grasses such as sand bluestem (*Andropogon hallii*), Indian grass (*Sorghastrum nutans*), swithgrass (*Panicum virgatum*), little bluestem, sideoats grama, and Canada wildrye (*Elymus canadensis*). Occasional trees such as junipers, and mesquite occur sporadically in this biome. Grazing has changed the

species composition of the grasses, with tobosa grass and western wheatgrass dominating at the expense of the climax species.

e. Riparian Community. The riparian community occurs along Canal Creek and its major tributary Cedar Creek. This community supports a dense growth of mesquite, soapberry (*Sapindus drummondii*), and salt cedars (*Tamarix gallica, T. ramosissima*), with occasional junipers intermixed among more common woody plants. The sloping stream banks have established stands of tall grasses, such as switchgrass and Canada wildrye.

f. Marsh Community. The marsh community exists around the larger farm ponds and is composed of tobosa grass, alkali sacaton (*Sporobolus airoides*), reed grass (*Phragmites communis*), and salt cedars.

3-03. **Major Species To Be Managed.** A detailed listing of all wildlife species indigenous to the basin is included in the Final Environmental Statement of the Red River Chloride Control Project dated July 1976. All species of wildlife, including game, non-game, and threatened or endangered species, will be given consideration in developing specific management plans. However, primary consideration will be directed toward indigenous species, including white-tailed deer (*Odocoileus virginianus*), scaled quail (*Callipepla squamata*), bobwhite quail (*Colinus virginianus*), wild turkey (*Meleagris galopovo*), cottontail (*Syvilligaus floridanus*), mourning dove (*Zenaidura macroura*), and migratory waterfowl. Management practices will not include the introduction and proliferation of exotic species. All wildlife management recommendations will be for the benefit of indigenous species and their habitats.

3-04. **Wildlife Management and Habitat Improvements.** Management practices outlined in this plan are designed to benefit all wildlife species. However, emphasis is being placed on the following game species:

a. White-tailed Deer. White-tailed deer are widespread throughout the general area, but are somewhat limited on project lands. The low population levels are probably linked to factors such as quality and abundance of browse, lack of mast producing trees and cropland, overgrazing, and predation. The existing population is tied closely to the mesquite thickets and riparian areas, especially where these habitat types are adjacent to agricultural lands. Deer are very adaptable and, if their preferred food supply is depleted, they often can switch to sub-optimal foods to survive. However, use of sub-optimal foods for extended periods can lead to decreased numbers and/or decreased overall health of the deer herd.

Deer feed primarily on forbs (herbaceous non-woody plants), browse (woody plants), grasses and grasslikes (grasses, rushes and sedges), mast (acorns), and agricultural crops. Use of these forage classes by deer will vary seasonally. Generally, during the spring and summer, deer select forbs when they are available, abundant, and actively growing. Browse is an important part of the diet during all seasons. Mast is generally available only during the fall and winter and is an important component during these seasons, while grasses become important during the fall and winter as forbs become scarce. Depending upon the crop, agricultural fields may also provide seasonal food. Wheat becomes important during the late fall and winter. Alfalfa is utilized in the spring and summer and corn or milo in the fall and winter.

Habitat improvement will be directed to increasing the carrying capacity of the area during all seasons. Cover and freshwater do not appear to be limiting factors for deer in the area. Consequently, initial management efforts will be directed primarily to improving food conditions.

The area has experienced severe overgrazing from past land use activities. Competition between deer and domestic livestock is intensified by poor habitat conditions such as those that exist on the mitigation area. Since cattle compete directly with deer by eating similar forb and browse species, grazing will not be used as a management tool initially. After project lands have had the opportunity to recover from overgrazing and after implementation of successful habitat improvement measures, a rotational grazing system with light to moderate stocking rates could possibly be considered for use as a management tool in selected areas.

b. Quail. The project area is inhabited by both bobwhite and scaled quail. The project area is at the western edge of the range for the bobwhite and near the eastern edge of the range for the scaled quail. Bobwhite typically inhabit brush lands, fence rows, and edges of cultivated fields. They are birds of low mobility, but have been shown to move up to 30 miles during the fall shuffle to find suitable winter habitat. Scaled quail are suited to the more open areas devoid of heavy ground cover. Both species feed primarily on seeds, fruits, and forbs. Insects are the primary food for juveniles. Good quail habitat provides escape cover, travel corridors, odd areas for resting, roosting, feeding, and nesting areas. Western ragweed is a major food item for this species and is locally abundant on disturbed areas. The edges of agricultural fields are also utilized for food. Well-drained ground with moderately open stands of tall grass and brush is preferred for nesting. The thicker stands of mesquite and juniper provide essential escape cover for these species.

The primary management strategy for this species is to maintain sufficient mesquite and juniper thickets for escape cover. Food plots will be developed to provide additional food sources. Large pasture areas will be broken up into smaller units and disked annually to encourage the growth of annual grasses and forbs for food. Existing farm ponds will be maintained to provide sources of water. Larger expanses of junipers and mesquite may be manipulated to increase stands of native grasses and provide diversity and edge.

c. Mourning Dove. Mourning dove occur in the area as both a resident and a migrant. Mesquite and juniper thickets provide excellent nesting and roosting sites for this species. Locally raised birds quickly migrate south in September, but are replaced by migrating doves from northern states. Mourning doves utilize harvested grain fields and overgrazed areas for feeding and farm ponds for watering.

The primary management strategy for this species is to maintain existing mesquite and juniper thickets for roosting and nesting. Food plots will be developed to provide additional food sources. Large pasture areas will be broken up into smaller units and disked annually to encourage the growth of annual grasses and forbs for food. Existing farm ponds will be maintained to provide sources of water. Larger expanses of junipers and mesquite may be manipulated to increase stands of native grasses and provide diversity and edge.

d. Turkey. Rio-Grande turkeys are native to and present in the general area, but populations are probably limited on the mitigation area by the lack of quality habitat. In addition, predation from coyotes and bobcats appears to be impacting this species, although lack of quality habitat is probably the chief reason for lack of this species in larger numbers. Turkeys require sites that have food sources, water, roosts, brood-rearing areas, nesting areas, and courting/display areas. Turkeys are highly mobile and can travel large distances to find their preferred habitat.

Grasses, berries, and insects are the major foods for turkeys during the summer. Turkeys eat both the leaves and seeds of grasses. In the fall, turkeys utilize late-maturing grasses and weeds such as wild rye, purple top, panic grass, and smartweed in addition to acorns. Harvested grain fields are also utilized for waste grain such as corn, milo, and haygrazer seeds. In the fall and spring, turkey heavily utilize the young shoots of wheat in addition to using clovers and fescue grasses.

Water is a very important component for establishment of turkeys. In addition to being essential for physiological requirements, hens usually build their nests within a quarter mile of water. Consequently, development of a water source within every square mile is considered important.

Nesting occurs in many places and has been found in association with alfalfa fields, old roads, fields, greenbrier clumps, sand plum thickets, mesquite, prickly pear, grasses, and forbs. Nests are commonly found on brushy hillsides, eroded ravine banks, and in association with fields.

Trees are necessary to provide escape cover and for roosts. Large cottonwood groves along stream courses are typically the preferred roost sites in western Texas.

Management practices to be implemented for the benefit of this species include the following:

(1) Protecting the existing riparian vegetation corridor along Cedar and Canal creeks.

(2) Planting additional roost trees (cottonwood or elm) in desirable areas along Cedar and Canal creeks, streams, and around farm ponds to increase roosting areas.

(3) Maintaining existing tall grass areas suitable for nesting cover and feeding areas.

(4) Developing food plots consisting of a mixture of clovers, ryegrass, and wheat to enhance winter and spring food sources.

(5) Maintaining existing farm ponds and creating additional farm ponds where feasible.

3-05. Mitigation Development. Authorized development activities associated with the mitigation area include fencing, signing, parking facilities, and roads.

a. Fencing. Fencing is a priority item for the mitigation area and is critical to successful management of the area. In accordance with the recommendations of the USFWS, the boundary of the mitigation area is to be fenced and monumented.

b. Access. The public will be provided access to the area at suitable access points. A parking area will be provided at each access point, and signs posting regulations will be provided.

c. Designation of Hunting Areas. All areas on the mitigation site shall be open to hunting, fishing, and other outdoor interests in accordance with applicable State and Federal laws. The boundaries of the area will be appropriately marked with signs to facilitate use by the public. Public hunting maps will be prepared and updated annually to insure uniformity between areas signed in the field and those shown on the maps. Information relative to hunting on public property will be printed on the reverse side of each map.

3-06. **Management Objectives and Goals.** The Crowell Brine Lake mitigation area shall be managed in accordance with the following goals and objectives:

(1) The primary purpose of the mitigation area shall be for propagation of fish and wildlife species and public use in accordance with appropriate State and Federal laws and regulations.

(2) Due to past land use practices and overgrazing of Crowell project lands, the grassland communities shall be protected and allowed to recover before any major habitat modifications involving grazing are implemented. The grassland communities should be managed for the benefit of climax species and for the reduction of increaser species.

(3) The riparian habitat along Canal and Cedar creeks and their associated floodplains represent the most valuable and productive habitat on the mitigation area for wildlife and should be **protected** over the life of the project.

(4) Other habitat types may be manipulated and managed in accordance with acceptable wildlife management practices including vegetative plantings, food plot development, brush hogging, disking, and controlled burning. Light rotational grazing on these areas (except the riparian zones along Canal and Cedar creeks) may become an option only after these habitats have had time to recover from overgrazing.

(5) The area shall be managed for indigenous native species of wildlife only.

(6) To facilitate wildlife management of the area, the vegetative communities shall be mapped and quantified. This mapping shall be completed utilizing the District's GIS capability.

(7) A detailed vegetative management plan shall be developed for the area utilizing the above mapping.

(8) Technical advice on management activities may be obtained from consultation with the TPWD and the USFWS, as needed.

(9) Management of the area shall be in accordance with and subject to the requirements of the upper Red River Ecosystem Components of the Environmental Operating Plan to be developed for the Wichita River portion of the Red River Chloride Control Project.

MANAGEMENT PRIORITIES	
TASK	**PRIORITY**
Monument and Fence Area Boundary	I
Sign Mitigation Area	I
Develop Public Access Points and Parking Areas	I
Map Vegetative Community	I
Develop Habitat Management Plan	I
Implement Management Goals	II
Fence Riparian Zones	II
Cross Fence Remainder of Area	III
Diversify Large Open Fields	II
Disk Fields	II
Plant Food Plots	III
Wildlife Plantings	II
Develop Farm Pond Management Plan	III
Implement Fishery Recommendations	III
Construct Additional Ponds	IV
Fence Ponds to Protect shoreline vegetation	III
Increase Riparian Zones around Ponds	II
Priority I items.	To be accomplished within the first 3 years.
Priority II items.	To be accomplished within the first 5 years.
Priority III and IV items.	To be accomplished after 5 years.